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(54) EVACUATOR WITH MOTIVE FIN

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Description

Technical Field

[0001] This application relates to vacuum creation by an evacuator and, more particularly, to an evacuator including a fin extending through the motive passageway.

Background

[0002] In some vehicles vacuum is used to operate or assist in the operation of various devices. For example, vacuum may be used to assist a driver applying vehicle brakes, turbocharger operation, fuel vapor purging, heating and ventilation system actuation, and driveline component actuation. If the vehicle does not produce vacuum naturally, such as from the intake manifold, then a separate vacuum source is required to operate such devices.

[0003] In boosted engines where intake manifold pressures are often at pressures greater than atmospheric pressure, intake manifold vacuum may be replaced or augmented with vacuum from an evacuator. Specifically, in one approach the evacuator may include an ejector. The ejector, as used herein, is a converging, diverging nozzle assembly with three connections, a motive port connected to a pressure source above atmospheric pressure, a discharge port connected to atmospheric pressure, and a suction port connected to a device requiring vacuum. By passing pressurized air through the ejector, a low pressure region is created within the ejector so that air can be drawn from a vacuum reservoir or may directly act on a device requiring vacuum, thereby reducing pressure within the vacuum reservoir or device requiring vacuum.

[0004] In another approach the evacuator may include an aspirator. As used herein, the aspirator is a converging, diverging nozzle assembly with three connections, a motive port connected to the intake air at atmospheric pressure, a discharge port connected to the manifold vacuum located downstream of the throttle, and a suction port connected to a device requiring vacuum. Similar to the ejector, a low pressure region may be created within the aspirator so that air can be drawn from a vacuum reservoir or may directly act on a device requiring vacuum, thereby reducing pressure within the vacuum reservoir or device requiring vacuum. There is a continuing need in the art for improved evacuators that generate increased vacuum pressure and increased suction mass flow rate while decreasing the consumption of engine air.

[0005] Different evacuators are shown by US 2013/0340732, DE 102004007319, US 2014/0360607, WO 2016/032843 and US 6293294.

Summary

[0006] The aforementioned needs are reached by an evacuator and a normally aspirated engine air system according to the appended set of claims.

[0007] Other aspects of the invention will be readily apparent in view of the descriptions and examples presented herein.

Brief Description of the Drawings

[0008]

FIG. 1 is a schematic diagram including flow paths and flow directions of one embodiment of an internal combustion engine turbo system including an evacuator.

FIG. 2 is a schematic view of the evacuator shown in FIG. 1.

FIG. 3 is a side perspective view of one embodiment of the evacuator of FIG. 2.

FIG. 4 is a cross-sectional side view of the pneumatically-actuated vacuum pump of FIG. 3, taken along section line B-B in FIG. 3.

FIG. 5 is an end view of the evacuator of FIG. 3 when viewed from the motive port.

FIG. 6 is cross-sectional side view of another embodiment of the evacuator of FIG. 2.

FIG. 7 is an illustrative representation of a cross-sectional view of the evacuator of FIG. 6 taken along section line C-C in FIG. 6, showing an outlet end of a first tapering portion of the evacuator.

FIG. 8 is an illustrative representation of a cross-sectional view of the evacuator of FIG. 6 taken along section line D-D in FIG. 6, showing an inlet end of a second tapering portion of the evacuator.

Detailed Description

[0009] The following detailed description will illustrate the general principles of the invention, examples of which are additionally illustrated in the accompanying drawings. In the drawings, like reference numbers indicate identical or functionally similar elements. As used herein, the term fluid may include any liquid, suspension, colloid, gas, plasma, or combinations thereof.

[0010] Referring now to FIG. 1, an exemplary turbocharged engine air system 10 for providing vacuum to a vehicle vacuum system is disclosed. The engine air system 10 may include an internal combustion engine 12, an air cleaner 14, an evacuator 20, a compressor 24, a turbine 26, a throttle 28, a vacuum reservoir or canister 30, and a vacuum consuming device 32. The internal combustion engine 12 may be, for example, a spark ignited (SI) engine or a compression ignition (CI) engine. In one embodiment, the internal combustion engine 12 may be included in an electric motor/battery system that is part of a hybrid vehicle. The throttle 28 may be located downstream of the air cleaner 14 and the compressor 24, and upstream of an intake manifold 42 of the internal combustion engine 12.

[0011] In the non-limiting embodiment as shown in FIG. 1, the internal combustion engine 12 is boosted. This means that the compressor 24 and turbine 26 may be part of a turbocharger for improving the power output and overall efficiency of the internal combustion engine 12. The turbine 26 may include a turbine wheel (not illustrated in FIG. 1) that harnesses and converts exhaust energy into mechanical work through a common shaft 40 to turn a compressor wheel (not illustrated in FIG. 1) of the compressor 24. The compressor wheel ingests, compresses, and feeds air at elevated operating pressures into the intake manifold 42 of the internal combustion engine 12. Although FIGS. 1 and 2 illustrate a boosted engine, it is to be understood that the disclosed evacuator 20 may be used in a normally-aspirated or non-boosted engine system as well.

[0012] The vacuum canister 30 may be supplied vacuum from the evacuator 20. In the embodiment as shown in FIG. 1, the evacuator 20 is supplied clean air from the compressor 24. Specifically, clean air at atmospheric pressure exits the air cleaner 14 and may be compressed by the compressor 24 before passing through the evacuator 20. As explained in greater detail below, the evacuator 20 may be used to supply vacuum to the vacuum canister 30. It is to be understood that although FIG. 1 illustrates the evacuator 20 being supplied air from the compressor 24, in another embodiment, the evacuator 20 may be positioned to receive air from the air cleaner 14 as well, for example in the case of a normally-aspirated or non-boosted engine system.

[0013] The throttle 28 may be opened as an operator depresses upon an accelerator pedal (not shown). When the throttle 28 is opened, compressed air from the compressor 24 is free to fill the intake manifold 42 of the internal combustion engine 12, thereby increasing the pressure at the intake manifold 42. Those skilled in the art will appreciate that the throttle 28 may be positioned in a plurality of partially opened positions based on the amount of depression of the accelerator (not shown). Since the engine air system 10 is turbocharged, the pressure at the intake manifold 42 may increase to a pressure that is above atmosphere as the throttle 28 is opened.

[0014] The evacuator 20 may include a first engine air connection 44, a second engine air connection 46, and a pneumatically-actuated vacuum pump 50 (shown in FIG. 2). The first engine air connection 44 of the evacuator 20 may be fluidly connected to the engine air system 10 at a location downstream of the compressor 24 and upstream of the throttle 28. The second engine air connection 46 of the evacuator 20 may be fluidly connected to the engine air system 10 at a location upstream of the intake manifold 42 and downstream of the throttle 28. Although the evacuator 20 is illustrated as supplying vacuum to the vacuum canister 30, those skilled in the art will appreciate that in an alternative embodiment, the evacuator 20 may directly supply vacuum to the vacuum consuming device 32.

[0015] The vacuum consuming device 32 may be a device requiring vacuum, such as a brake booster. In an embodiment, the vacuum consuming device 32 may also include additional vacuum consumers as well, such as, for example, turbocharger waste gate actuators, heating and ventilation actuators, driveline actuators (e.g., four wheel drive actuators), fuel vapor purging systems, engine crankcase ventilation, and fuel system leak testing systems.

[0016] FIG. 2 is a schematic diagram of an embodiment of the evacuator 20 shown in FIG. 1, and illustrates the pneumatically-actuated vacuum pump 50. Referring to FIGS. 1-2, as used herein, the pneumatically-actuated vacuum pump 50 may be a converging, diverging nozzle assembly with three or more connections. The pneumatically-actuated vacuum pump 50 includes a motive port 70 fluidly connected to the first engine air connection 44, a discharge port 74 fluidly connected to the second engine air connection 46, and one or more suction ports 72 fluidly connected to the vacuum canister 30 (FIG. 1) or to one or more devices requiring vacuum 32. Specifically, the motive port 70 of the evacuator 50 may be fluidly connected to the engine air system 10 downstream of the compressor 24, and the discharge port 74 may be fluidly connected to the engine air system 10 upstream of the intake manifold 42. Those skilled in the art will readily appreciate that although FIG. 2 illustrates one suction ports 72 it is to be understood that the pneumatically-actuated vacuum pump 50 may include additional suction port(s) 72.

[0017] In the embodiment as shown in FIG. 2, the pneumatically-actuated vacuum pump 50 may act as an ejector, where boosted air that is above atmospheric pressure may be fed to the evacuator 20 through the motive port 70. However, those skilled in the art will readily appreciate that in an alternative embodiment, the motive port 70 of the pneumatically-actuated vacuum pump 50 may be fluidly connected to a source of air that is at atmospheric pressure such that the pneumatically-actuated vacuum pump 50 acts as an aspirator.

[0018] Referring to FIGS. 3-5, an embodiment of the pneumatically-actuated vacuum pump 50 is shown. FIG. 3 is a perspective view, FIG. 4 is a side cross-sectional view taken along line B-B of FIG. 3, and FIG. 5 is an end view from the perspective of the motive port 70. A passageway 80 that extends along axis A-A of the pneumatically-actuated vacuum pump 50 includes a first tapering portion 92 (also referred to as a motive cone) in a motive section 90 of the passageway 80. The passageway 80 also includes a second tapering portion 93 (also referred to as a discharge cone) in a discharge section 95 of the passageway 80. The first tapering portion 92 of the passageway 80 includes an inlet end 94 and an outlet end 96. Similarly, the second tapering portion 93 of the passageway 80 also includes an inlet end 98 and an outlet end 100.

[0019] As seen in FIG. 4, the first tapering portion 92 of the pneumatically-actuated vacuum pump 50 is fluidly coupled to the second tapering portion 93 by a Venturi gap 102. The Venturi gap 102 is a fluid junction that places the suction port 72 in fluid communication with the motive section 90 and the discharge section 92 of the pneumatically-actuated vacuum pump 50. The Venturi gap 102 is the lineal distance **L** measured between the outlet end 96 of the first tapering portion 92 and the inlet end 98 of the second tapering portion 93. The inlet ends 94, 98 and the outlet ends 96, 100 include any type of profile, such as, but not limited to, a circular shape, an ellipse shape, or another curved or polygonal form. Moreover, the gradually, continuously tapering inner diameter extending from inlet ends 94, 98 and the outlet ends 96, 100 of the passageway 80 may define a hyperboloid, a paraboloid, or a cone. Some exemplary configurations for the outlet end 96 of the first tapering portion 92 and the inlet end 98 of the second tapering portion 93 are presented in FIGS. 4-6 of co-pending U.S. Patent Application No. 14/294,727, filed on June 3, 2014. A plurality of additional Venturi gaps (not shown) may be located downstream of the Venturi gap 102, along the second tapering portion 93 of the pneumatically-actuated vacuum pump 50. Some exemplary configurations of a pneumatically-actuated vacuum pump with a plurality of Venturi gaps are presented in FIGS. 2-5C of co-pending U.S. Patent Application No. 14/452,651 filed on August 6, 2014.

[0020] Referring now to FIGS. 3-6, the pneumatically-actuated vacuum pump 5 includes a fin 82 that is substantially aligned with a central axis of symmetry A-A of the pneumatically-actuated vacuum pump 50. The fin 82 is used to reduce the motive flow rate required by the evacuator 20 in order to produce a specific amount of vacuum that is supplied to the vacuum canister 30. The fin 82 also increases the perimeter area between the motive flow and the suction flow, increasing suction flow. The fin 82 is a rigid structure integrally formed into a housing 110 of the pneumatically actuated vacuum pump 50, for example as part of an injection molding process. The fin 82 may alternately be permanently attached to the housing 100 of the pneumatically-actuated vacuum pump 50. The integral or permanent attachment of the fin 82 to the housing 110 of the pump 50 provides stability to the fin 82 in use, substantially preventing or minimizing vibration of the fin 82, which could otherwise increase turbulence and/or noise. The fin functions similarly to a fletch insert, as disclosed and described in copending U.S. Provisional Pat. App. No. 62/042,569, filed August 27, 2014.

[0021] The fin 82 may include a first portion 112 disposed within the first tapering portion 92 of the pneumatically-actuated vacuum pump 50 and a second portion 114 disposed within the second tapering portion 93 of the pump 50. The fin 82 extends radially inwardly towards the axis of symmetry A-A from an inner surface 122 of the tapering portions 92, 93, into a void 124 defined by the passageway 80. The fin 82 extends radially into the void 124 from a base 118 of the fin 82 to terminate in an upper surface 120 thereof. The base 118 extends through the passageway 80 coextensively with the inner surface 122 in the direction of the axis of symmetry A-A. The fin 82 may have a non-uniform height along its length, and in one embodiment, generally increase in height through the first tapering portion 92 and generally decrease in height through the second tapering portion 93. In the depicted embodiment, the fin 82 has a rounded, trapezoidal cross-sectional shape (seen in FIGS. 3 and 5). However, those skilled in the art should appreciate that the fin 82 is not limited as such, but may have, for example, a cross-sectional shape that is substantially semi-elliptical, semi-circular, or any of a variety of curved or polygonal shapes, depending on the motive flow characteristics required for the particular application of the pneumatically-actuated vacuum pump 50.

[0022] As shown in FIG. 4, in one embodiment, the fin 82 extends continuously from the inlet end 94 of the first tapering portion 92, through the Venturi gap 102, and on to the outlet end 100 of the second tapering portion 93. The fin 82 may gradually increase in height through the first tapering portion 92 to a maximum height at or near the Venturi gap 102, and then gradually decrease in height through the second tapering portion 93. The fin 82 extends along substantially the entire distance between the outlet ends 96, 100 (as shown in FIG. 4), or alternately begin/terminate at intermediate location(s) within the length of the passageway 80.

[0023] The fin 82 provides various advantages and benefits during operation of the pneumatically-actuated vacuum pump 50. The fin 82 decreases the amount of motive flow or air flow required by the pneumatically-actuated vacuum pump 50 in order to generate a specific amount of suction. This means that the pneumatically-actuated vacuum pump 50 requires less air flow than an evacuator that does not include a fin 82 in order to create the same amount of vacuum. As seen in FIG. 5, the fin 82 fills up or blocks off a portion of the void 124 located within the passageway 80 of the pneumatically-actuated vacuum pump 50. The motive flow entering the pneumatically-actuated vacuum pump 50 has a smaller volume to fill in the passageway 80 of the pump 50, as compared to an evacuator of the same dimensions, but lacking the fin 82. Thus, less air is required to enter the motive port 70 (see FIG. 3) of the pneumatically-actuated vacuum pump 50 in order to generate the same amount of suction in the vacuum canister 30, as compared to an evacuator that does not include a fin.

[0024] FIGS. 6-8, depict an alternative embodiment of a pneumatically-actuated vacuum pump 50', in which a fin 82' does not extend through the Venturi gap 102. In this embodiment, there is a gap 116 located between a first portion 112' and a second portion 114' of the fin 82', where each portion 112', 114' is a separate fin segment.

As shown in FIGS. 7 and 8, which are cross-sectional views of the passageway 80 taken at the Venturi gap 102 along lines C-C and D-D of FIG. 6 showing the outlet end 96 of the first tapering portion 92 and the inlet end 98 of the second tapering portion 93, each of the portions 112', 114' of the fin 82' terminates in an end 126, 128 at or near the Venturi gap 102. Each end 126, 128 has a face 127, 129 oriented toward the Venturi gap 102. The faces 127, 129 (or a plane defined by either face 127, 129) may orthogonally or obliquely intersect the axis of symmetry A-A. The face 127 of the first portion 112' and the face 129 of the second portion 114' may be generally aligned across the Venturi gap 102. For example, if both of the faces 127, 129 are the same size and shape (in cross-section), the ends 126, 128 may be substantially identically positioned within their respective tapering portions 92, 93 relative to the axis of symmetry A-A, such that the face 127 of the first portion 112' would substantially coincide with the face 129 of the second portion 114' if one of the ends 126, 128 were extended linearly across the Venturi gap 102. If the faces 127, 129 are not the same size and/or shape, the ends 126, 128 may nonetheless be generally aligned if each end 126, 128 is positioned within its respective tapering portions 92, 93 to maximize symmetrical positioning of the faces 127, 129 relative to each other across the Venturi gap 102. For example, FIGS. 7 and 8 show faces 127, 129 with the generally the same shape but of different sizes, where both are generally aligned through centered placement of the portions 112', 114' within the tapering portions 92, 93.

[0025] The faces 126, 128 of the portions 112', 114' of the fin 82' influence the interior perimeter shapes/profiles of the outlet end 96 of the first tapering portion 92 and the inlet end 98 of the second tapering portion 93. In the depicted embodiment, the interior perimeter shapes of both ends 96, 98, including the fin 82', are generally horseshoe-shaped (i.e., the cross-sectional shape of the void 24 of the passageway 80 at or near each of the ends 96, 98 is generally horseshoe-shaped). However, it is to be understood that this illustration is merely exemplary, and the interior perimeter shape of the ends 96, 98 may include other profiles as well. In one embodiment, the height H_1 and/or width W_1 of the portion 112' of fin 82' at the Venturi gap 102 is greater than the height H_2 and/or width W_2 of the portion 114' of fin 82' at the Venturi gap 102. In an alternate embodiment, the width of the fin 82' tapers as the fin 82' approaches the Venturi gap 102 (on one or both ends 126, 128), such that the faces 127, 129 are substantially thinner than depicted in FIGS. 7 and 8 (for example, almost linear, in one embodiment).

[0026] In a further alternate embodiment (not shown), the fin 82' may include only the first portion 112' through the first tapering portion 92, and omits the second portion 114' in the second tapering portion 93.

[0027] Continuing to refer to FIGS. 6-8, in addition to improving efficiency through reducing the motive flow required to generate the requisite amount of suction, the fin 82' provides further opportunities to fine tune the desired suction flow rate and depth of vacuum of the pump 50', based on the relationship between the shapes, size, and positioning of the faces 127, 129 of the fin 82' on either side of the Venturi gap 102. In addition to the lineal distance **L** between the outlet end 96 of the first tapering portion 92 and the inlet end 98 of the second tapering portion 93, the perimeter shape of the outlet end 96 also impacts the suction flow rate. Specifically, a larger perimeter results in increased suction flow. Also, the magnitude of the offset (i.e., the degree to which the area of the inlet end 98 is larger than the area of the outlet end 96) impacts both the suction flow rate and the depth of vacuum generated. These relationships are described in U.S. Pat. App. No. 14/294,727, filed June 3, 2014, and U.S. Provisional Pat. App. No. 62/042,568, filed August 27, 2014.

[0028] Fin 82' provides enhanced options for both maximizing suction flow rate and increasing the depth of vacuum. Referring to FIGS. 7 and 8, with respect to suction flow rate, the shape of the face 127 at the end 126 of first portion 112' of the fin 82' substantially increases the total internal perimeter of the outlet end 96 (as shown, defining a generally horseshoe shaped void), as compared to an outlet end for a similarly-sized first tapered portion 92 without a fin 82', which would be generally elliptical in shape. Accordingly, the potential suction flow rate of the pump 50' across a Venturi gap 102 is substantially increased as compared to an identical pump lacking a fin 82'. Further, to adjust the suction flow capabilities between applications (for example, to modify the design of the pump 50' for a different application), it may be possible to change the shape and/or size of the fin 82' alone, without the need to change the shape or size of the passageway 80 in other respects, such as by changing the shape or size of the first tapering portion 92.

[0029] Still referring to FIGS. 7 and 8, the fin 82' also expands the design options for controlling depth of vacuum parameters for the pump 50'. Depth of vacuum is a function of the magnitude of the offset between the inlet end 98 and the outlet end 96 of the Venturi gap 102. The smaller the offset, the greater the depth of vacuum. Accordingly, in addition to (or instead of) varying the shape and/or size of the overall perimeter shapes of the ends 96, 98 aside from the fin 82' (in other words, the overarching elliptical shape, in the example of FIGS. 7 and 8), offset of the pump 50' can be adjusted by varying the size and/or changing the shape of the face 128 of the second portion 114' of the fin 82' at the inlet end 98. For example offset can be increased by reducing the height H_2 and/or width W_2 of the face 128 on the inlet end 98 relative to the height H_1 and/or width W_1 of the face 126 of the outlet end 126. Accordingly, the shape and size of the first and second portions 112', 114' of the fin 82' can be optimized relative to each other, to set the suction flow rate and the depth of vacuum characteristics of the pump 50' according to the required performance criteria.

Claims

1. An evacuator (50, 50'), comprising:

a body (110) defining a central axis of symmetry (A-A), a first tapering portion (92), a second tapering portion (93) defining a passageway (80) through the body, at least one Venturi gap (102) located between an outlet end (96) of the first tapering portion and an inlet end (98) of the second tapering portion, and a suction port (72) in fluid communication with the Venturi gap (102), wherein the outlet end (96) of the first tapering portion defines an elliptically-shaped first opening into the at least one Venturi gap;
characterized in that
a single fin (82, 82') integral with the body (110) protrudes radially inward into the passageway (80) from an inner surface (122) of the first and second tapering portions (92, 93) and extends in the direction of the central axis of symmetry (A-A) with a length from a starting point at the inlet end (94) of the first tapering portion (92) or an intermediate position within the first tapering portion (92) of the body to an ending point at the outlet end (100) of the second tapering portion (93) or an intermediate position within the second tapering portion (93);
wherein the fin (82) is either continuous through the Venturi gap (102) or discontinuous at the Venturi gap (102) and has a base that extends through the passageway (80) coextensively with the inner surface (122).

2. The evacuator of claim 1, wherein the fin (82) is discontinuous at the Venturi gap (102) and defines a first face (127) at the outlet end (96) of the first tapering portion and a second face (129) at the inlet end (98) of the second tapering portion.

3. The evacuator of claim 2, wherein a perimeter length of the second face (129) is greater than a perimeter of the first face (127) .

4. The evacuator of claim 1, wherein the fin (82) has a variable height along a length of the fin.

5. The evacuator of claim 4, wherein the fin (82) has a maximum height at Venturi gap (102).

6. The evacuator of claim 1, wherein the first tapering portion (92) is a converging motive portion and wherein the second tapering portion (93) is a diverging discharge portion.

7. The evacuator of claim 1, wherein the inlet end (98) of the second tapering portion (93) defines an elliptically-shaped second opening at the Venturi gap (102).

8. The evacuator of claim 1, wherein the fin (82) has a generally semi-elliptical or semi-circular shape as a cross-sectional shape thereof.

9. The evacuator of claim 8, wherein the shape of the void at the outlet end (96) of the first tapering portion (92) is a generally horseshoe-shaped void.

10. A turbocharged engine air system (10), comprising:

a device requiring vacuum (32);
a turbocharger (24 and 26) having a compressor fluidly connected to an intake manifold (42) of an engine (12); and
an evacuator (20) according to any of claims 1 to 9;
wherein the second tapering portion (93) of the evacuator (20) is fluidly connected to the intake manifold (42) of the engine (12) at a location downstream of the compressor (24), and the suction port (72) of the evacuator (20) is fluidly connected to the device requiring vacuum (32).

11. A non-boosted engine air system, comprising:

a device requiring vacuum (32);
an intake manifold (42) of an engine (12); and
an evacuator (20) according to any of claims 1 to 9; and
wherein the second tapering portion (93) of the evacuator (20) is fluidly connected to the intake manifold (42) of the engine (12) and the suction port (72) of the evacuator (20) is fluidly connected to the device requiring vacuum (32).

Patentansprüche

1. Evakuator (50, 50'), aufweisend:

einen Körper (110), der eine zentrale Symmetrieachse (A-A) definiert, einen ersten konischen Abschnitt (92), einen zweiten konischen Abschnitt (93), die einen Durchgang (80) durch den Körper definieren, wenigstens einen Venturi-Spalt (102), der zwischen einem Auslassende (96) des ersten konischen Abschnitts und einem Einlassende (98) des zweiten konischen Abschnitts angeordnet ist und eine Ansaugöffnung (72), die in fluidmäßiger Verbindung steht mit dem Venturi-Spalt (102), wobei das Auslassende (96) des ersten konischen Abschnitts eine elliptisch geformte erste Öffnung in den wenigstens einen Venturi-Spalt definiert;
dadurch gekennzeichnet, dass
eine einzelne Rippe (82, 82'), die integral mit

dem Körper (110) ist, radial nach innen in den Durchgang (80) ragt von einer inneren Fläche (122) der ersten und zweiten konischen Abschnitte (92, 93) und sich in der Richtung der zentralen Symmetrieachse (A-A) erstreckt mit einer Länge von einem Anfangspunkt am Einlassende (94) des ersten konischen Abschnitts (92) oder einer zwischenliegenden Stelle innerhalb des ersten konischen Abschnitts (92) des Körpers zu einem Endpunkt an dem Auslassende (100) des zweiten konischen Abschnitts (93) oder einer zwischenliegenden Stelle innerhalb des zweiten konischen Abschnitts (93);
wobei die Rippe (82) entweder durchgehend durch den Venturi-Spalt (102) ist oder an dem Venturi-Spalt (102) unterbrochen ist und eine Basis hat, die sich durch den Durchgang (80) koextensiv mit der inneren Fläche (122) erstreckt.

2. Evakuator nach Anspruch 1, wobei die Rippe (82) an dem Venturi-Spalt (102) unterbrochen ist und eine erste Fläche (127) an dem Auslassende (96) des ersten konischen Abschnitts und eine zweite Fläche (129) an dem Einlassende (98) des zweiten konischen Abschnitts definiert.

3. Evakuator nach Anspruch 2, wobei eine Umfangslänge der zweiten Fläche (129) grö-βer ist als ein Umfang der ersten Fläche (127).

4. Evakuator nach Anspruch 1, wobei die Rippe (82) eine variable Höhe entlang einer Länge der Rippe hat.

5. Evakuator nach Anspruch 4, wobei die Rippe (82) eine maximale Höhe beim Venturi-Spalt (102) hat.

6. Evakuator nach Anspruch 1, wobei der erste konische Abschnitt (92) ein konvergierender Triebabschnitt und wobei der zweite konische Abschnitt (93) ein divergierender Abführabschnitt ist.

7. Evakuator nach Anspruch 1, wobei das Einlassende (98) des zweiten konischen Abschnitts (93) eine elliptisch geformte zweite Öffnung bei dem Venturi-Spalt (102) definiert.

8. Evakuator nach Anspruch 1, wobei die Rippe (82) eine im Allgemeinen halbelliptische oder halbkreisförmige Form als ihre Querschnittsform hat.

9. Evakuator nach Anspruch 8, wobei die Form des leeren Raumes an dem Auslassende (96) des ersten konischen Abschnitts (92) ein im Allgemeinen hufeisenförmiger leerer Raum ist.

10. Turbogeladenes Motor-Luft-System (10), aufweisend:

eine Vorrichtung, die Vakuum (32) erfordert;
einen Turbolader (24 und 26), der einen Kompressor hat, der fluidmäßig verbunden ist mit einem Ansaugstutzen (42) eines Motors (12); und
einen Evakuator (20) nach einem der Ansprüche 1 bis 9;
wobei der zweite konische Abschnitt (93) des Evakuators (20) fluidmäßig mit dem Ansaugstutzen (42) des Motors (12) an einer Stelle stromabwärts des Kompressors (24) verbunden ist und die Ansaugöffnung (72) des Evakuators (20) fluidmäßig mit der Vorrichtung (32) verbunden ist, die Vakuum erfordert.

11. Motor-Luft-System ohne Verstärkung, aufweisend:

eine Vorrichtung (32), die Vakuum erfordert;
einen Ansaugstutzen (42) eines Motors (12); und
einen Evakuator (20) nach einem der Ansprüche 1 bis 9; und
wobei der zweite konische Abschnitt (93) des Evakuators (20) fluidmäßig mit dem Ansaugstutzen (42) des Motors (12) verbunden ist und die Ansaugöffnung (72) des Evakuators (20) fluidmäßig mit der Vorrichtung (32) verbunden ist, die Vakuum erfordert.

Revendications

1. Évacuateur (50, 50'), comprenant :

un corps (110) définissant un axe de symétrie (A-A) central, une première portion effilée (92), une seconde portion effilée (93) définissant un passage (80) à travers le corps, au moins un espace Venturi (102) situé entre une extrémité de sortie (96) de la première portion effilée et une extrémité d'entrée (98) de la seconde portion effilée, et un orifice d'aspiration (72) en communication de fluide avec l'espace Venturi (102), dans lequel l'extrémité de sortie (96) de la première portion effilée définit une première ouverture de forme elliptique dans l'au moins un espace Venturi ;
caractérisé en ce que
une seule ailette (82, 82') formant un seul bloc avec le corps (110) fait saillie radialement vers l'intérieur dans le passage (80) à partir d'une surface intérieure (122) des première et seconde portions effilées (92, 93) et s'étend dans la direction de l'axe de symétrie (A-A) central avec une longueur à partir d'un point de départ au niveau de l'extrémité d'entrée (94) de la première portion effilée (92) ou d'une position intermé-

diaire dans la première portion effilée (92) du corps jusqu'à un point final au niveau de l'extrémité de sortie (100) de la seconde portion effilée (93) ou d'une position intermédiaire dans la seconde portion effilée (93) ;
dans lequel l'ailette (82) est soit continue à travers l'espace Venturi (102) soit discontinue au niveau de l'espace Venturi (102) et a une base qui s'étend à travers le passage (80) de manière coextensive avec la surface intérieure (122).

2. Évacuateur selon la revendication 1, dans lequel l'ailette (82) est discontinue au niveau de l'espace Venturi (102) et définit une première face (127) au niveau de l'extrémité de sortie (96) de la première portion effilée et une seconde face (129) au niveau de l'extrémité d'entrée (98) de la seconde portion effilée.

3. Évacuateur selon la revendication 2, dans lequel une longueur de périmètre de la seconde face (129) est plus grande qu'un périmètre de la première face (127).

4. Évacuateur selon la revendication 1, dans lequel l'ailette (82) a une hauteur variable le long d'une longueur de l'ailette.

5. Évacuateur selon la revendication 4, dans lequel l'ailette (82) a une hauteur maximale au niveau d'un espace Venturi (102).

6. Évacuateur selon la revendication 1, dans lequel la première portion effilée (92) est une portion motrice convergente et dans lequel la seconde portion effilée (93) est une portion de rejet divergente.

7. Évacuateur selon la revendication 1, dans lequel l'extrémité d'entrée (98) de la seconde portion effilée (93) définit une seconde ouverture de forme elliptique au niveau de l'espace Venturi (102).

8. Évacuateur selon la revendication 1, dans lequel l'ailette (82) a une forme généralement semi-elliptique ou semi-circulaire en tant que forme transversale de celle-ci.

9. Évacuateur selon la revendication 8, dans lequel la forme de l'espace vide au niveau de l'extrémité de sortie (96) de la première portion effilée (92) est un espace vide généralement en forme de fer à cheval.

10. Système d'air de moteur (10) à turbocompresseur, comprenant :

un dispositif (32) nécessitant un vide ;
un turbocompresseur (24 et 26) ayant un compresseur relié de manière fluidique à un collecteur d'admission (42) d'un moteur (12) ; et
un évacuateur (20) selon l'une quelconque des revendications 1 à 9 ;
dans lequel la seconde portion effilée (93) de l'évacuateur (20) est reliée de manière fluidique au collecteur d'admission (42) du moteur (12) à un emplacement en aval du compresseur (24), et l'orifice d'aspiration (72) de l'évacuateur (20) est relié de manière fluidique au dispositif (32) nécessitant un vide.

11. Système d'air de moteur non amplifié, comprenant :

un dispositif (32) nécessitant un vide ;
un collecteur d'admission (42) d'un moteur (12) ; et
un évacuateur (20) selon l'une quelconque des revendications 1 à 9 ; et
dans lequel la seconde portion effilée (93) de l'évacuateur (20) est reliée de manière fluidique au collecteur d'admission (42) du moteur (12) et l'orifice d'aspiration (72) de l'évacuateur (20) est relié de manière fluidique au dispositif (32) nécessitant un vide.

FIG. 1

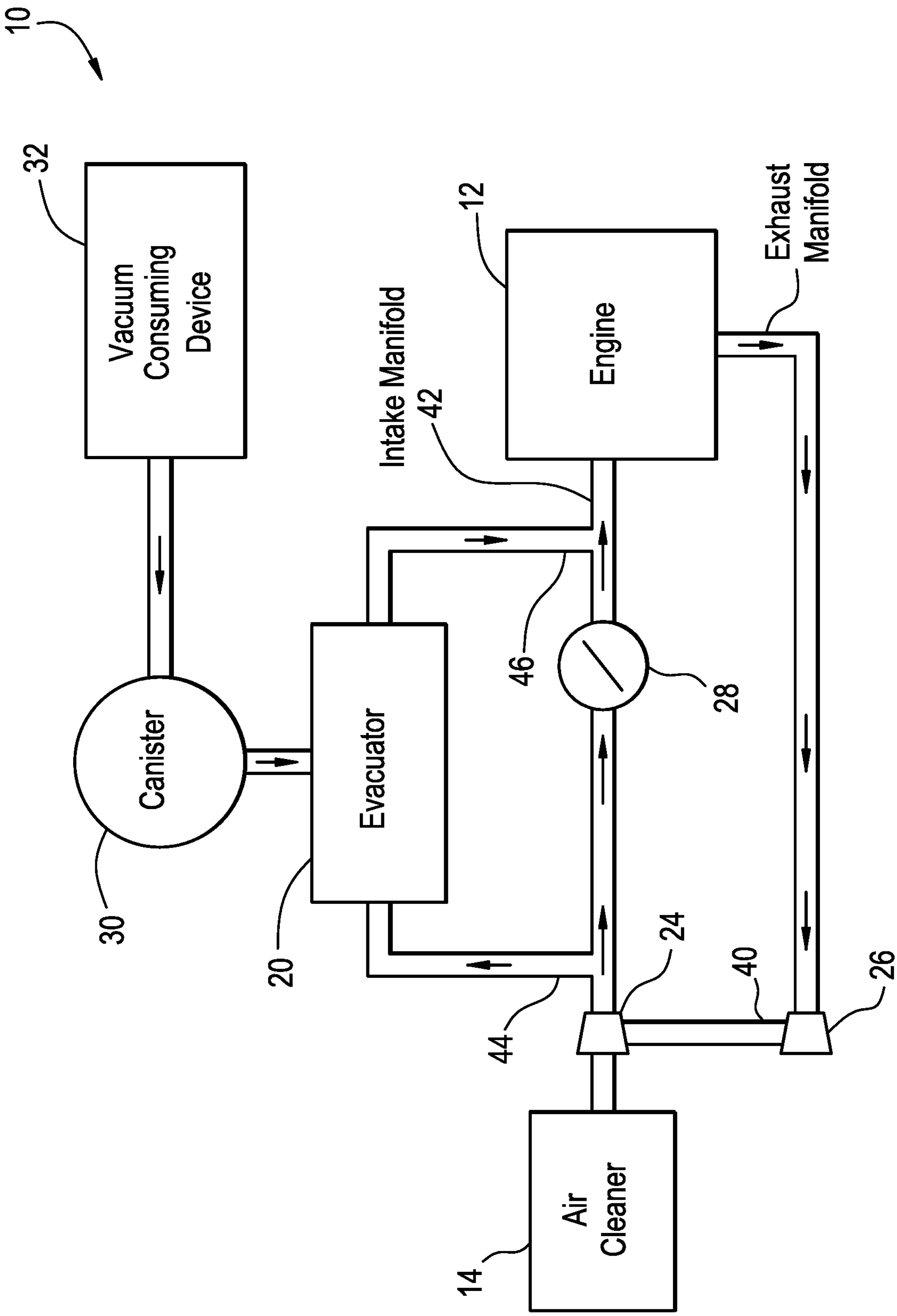

10
32
Vacuum Consuming Device
12
Engine
Exhaust Manifold
Intake Manifold
42
Canister
Evacuator
46
28
30
20
24
40
26
44
Air Cleaner
14

FIG. 2

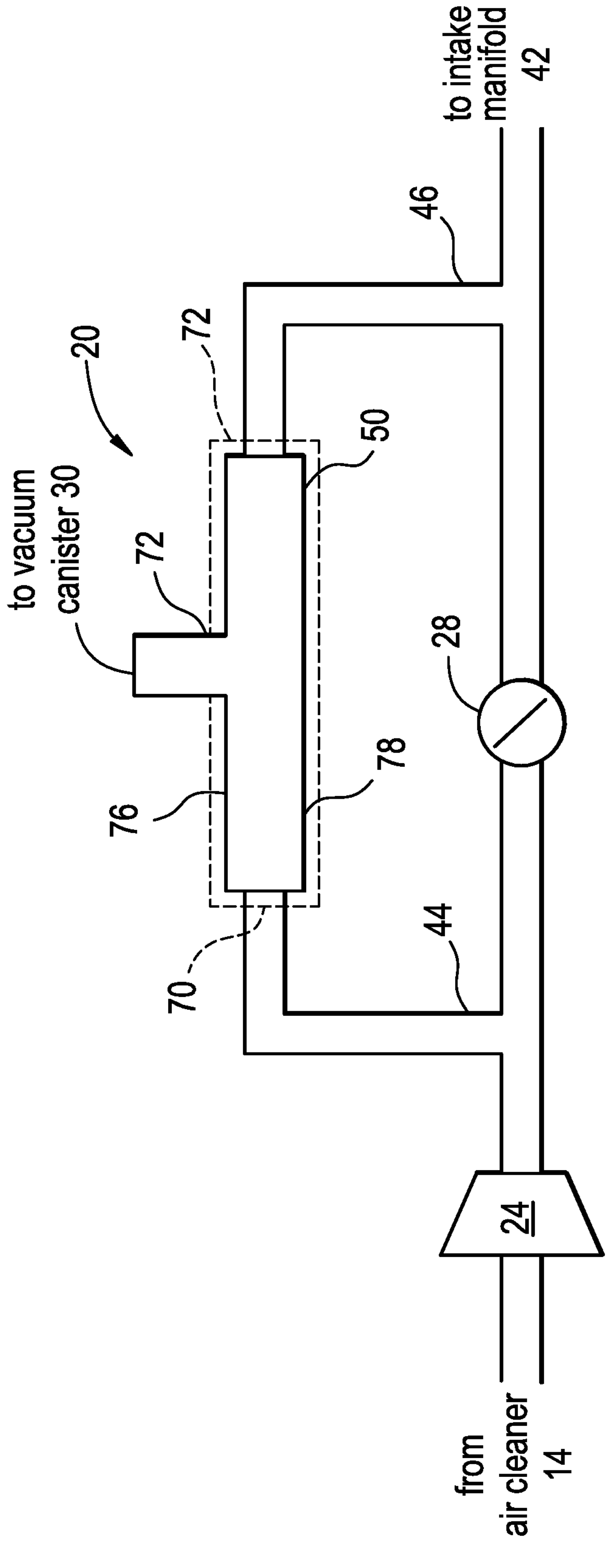

to vacuum canister 30
to intake manifold 42
from air cleaner 14
20
24
28
44
46
50
70
72
72
76
78

FIG. 3

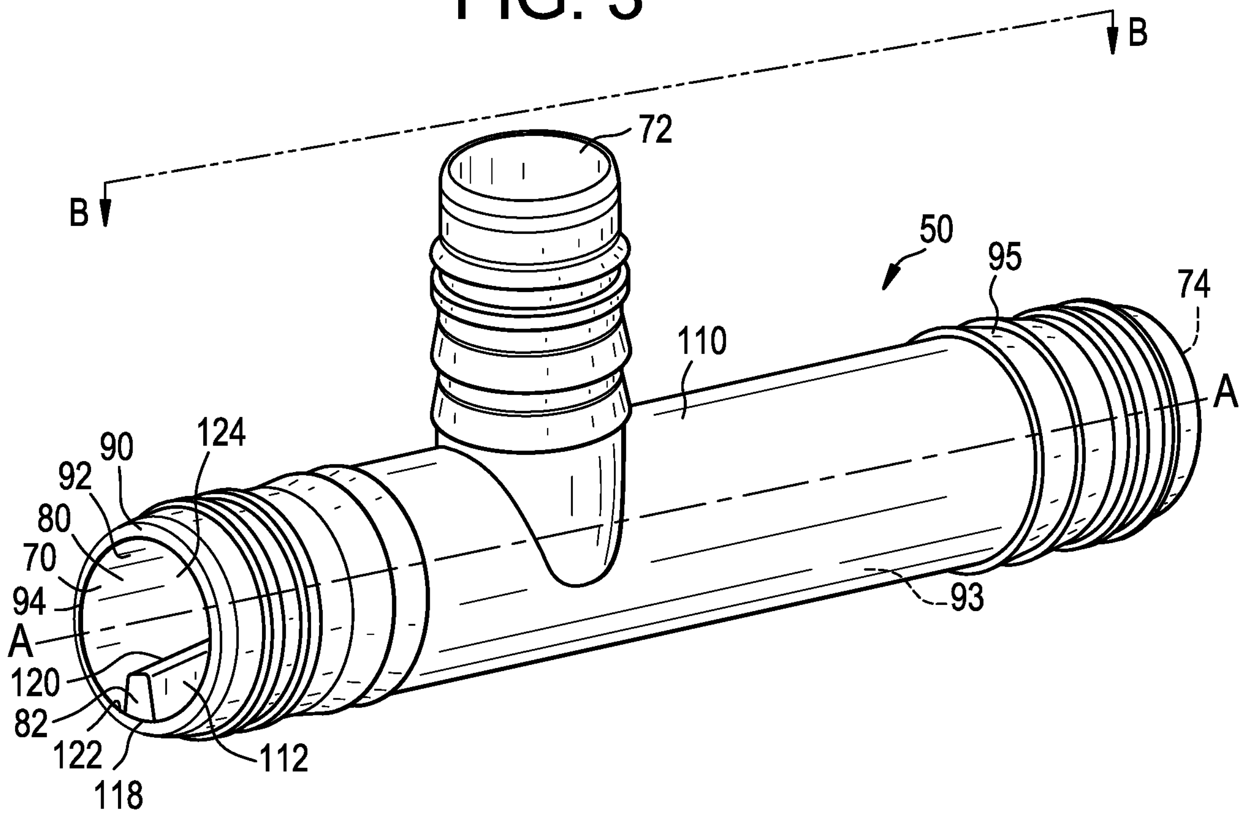

B
B
72
50
95
74
110
A
124
90
92
80
70
94
A
93
120
82
122
118
112

FIG. 4

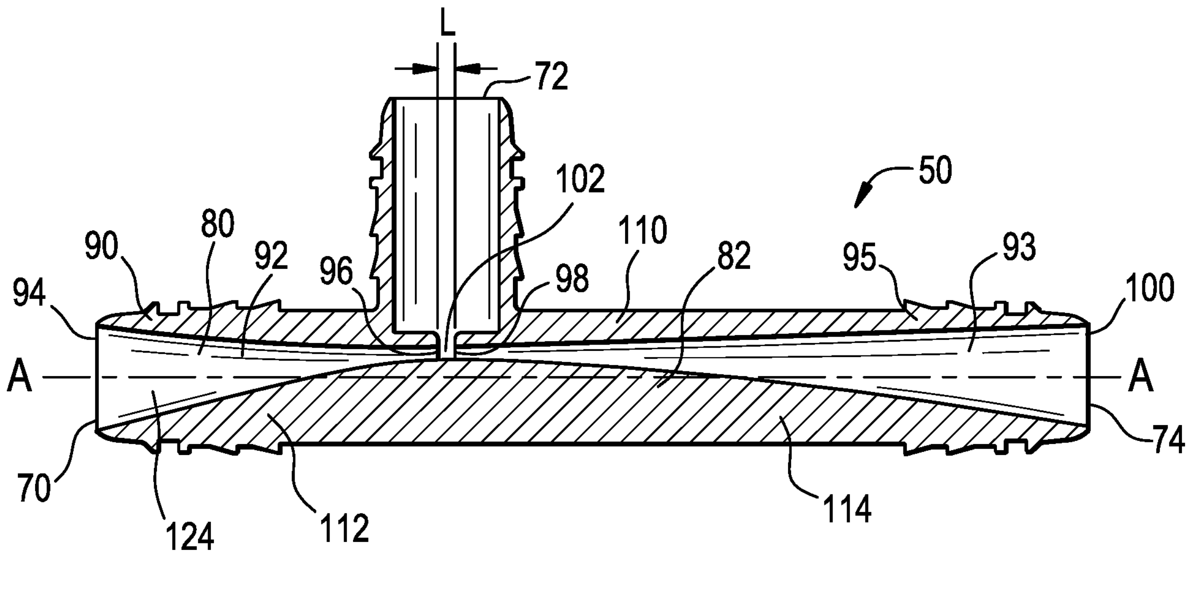

L
72
50
102
110
90
80
92
96
98
82
95
93
100
94
A
A
70
74
124
112
114

FIG. 5

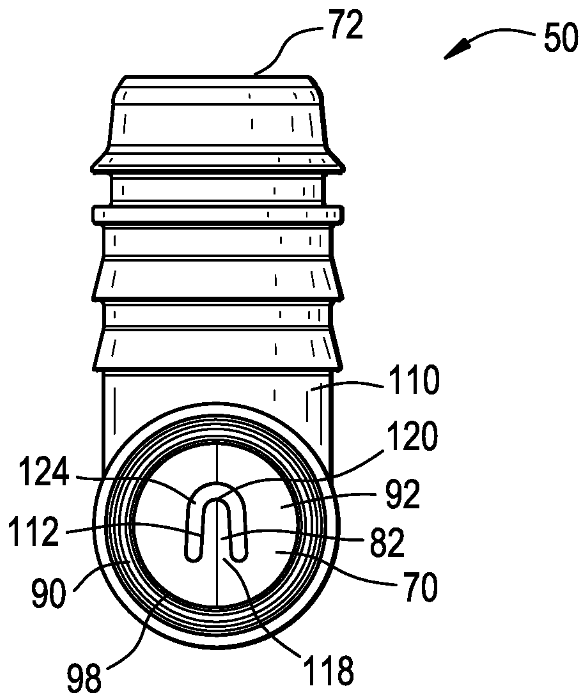

72
50
110
120
124
92
112
82
90
70
98
118

FIG. 6

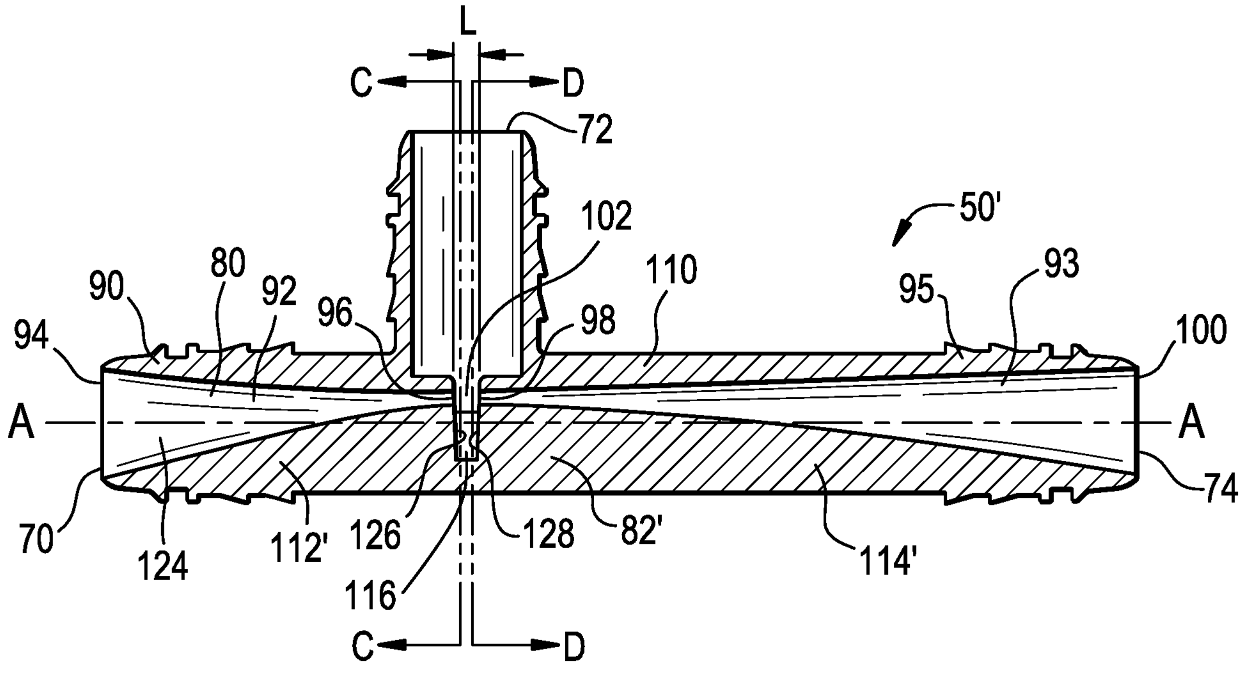

L
C
D
72
102
50'
90
80
92
96
110
95
93
94
98
100
A
A
70
124
112'
126
128
82'
114'
74
116
C
D

FIG. 7

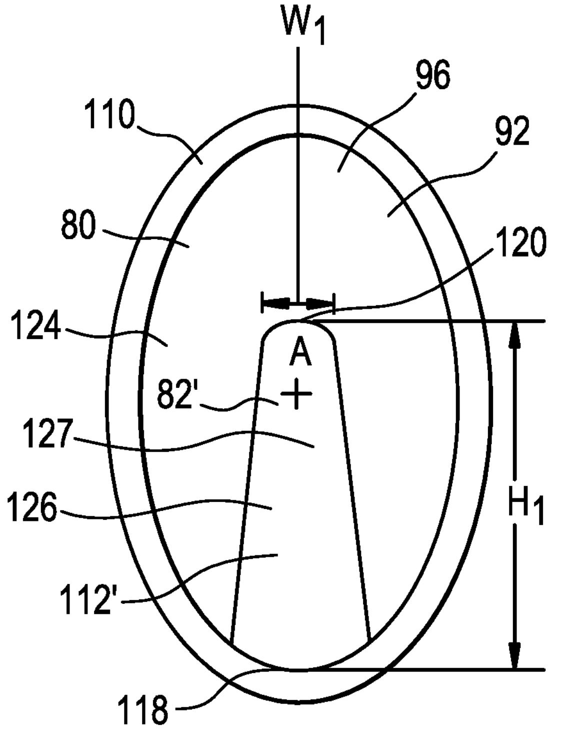
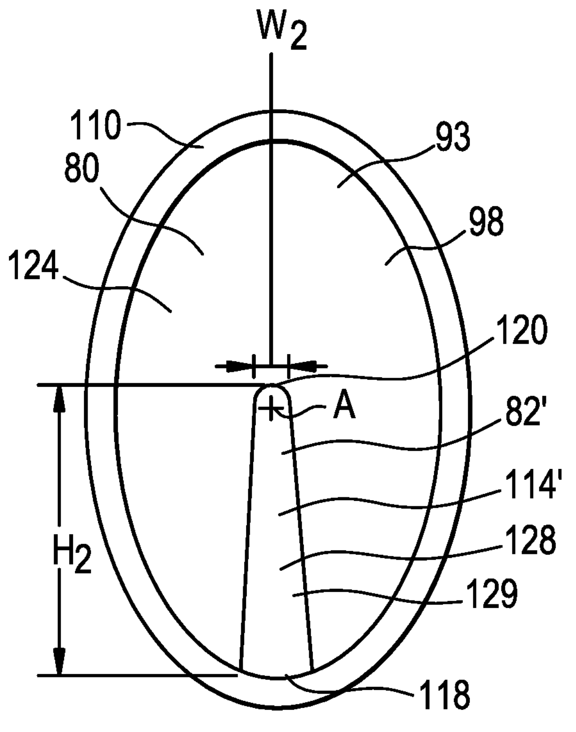

W1
96
110
92
80
120
124
A
82'
127
H1
126
112'
118

FIG. 8


W2
110
93
80
98
124
120
A
82'
114'
H2
128
129
118

REFERENCES CITED IN THE DESCRIPTION

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